

FORM PTO-1390 (Modified) (REV 11-98)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER
				PF980059
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 09/786432		
INTERNATIONAL APPLICATION NO. PCT/EP99/06556	INTERNATIONAL FILING DATE 06. September 1999 (06.09.99)	PRIORITY DATE CLAIMED 07 September 1998 (07.09.98)		
TITLE OF INVENTION METHOD OF MOTION ESTIMATION FOR TRANSMISSION COST REDUCTION OF MOTION VECTORS				
APPLICANT(S) FOR DO/EO/US Christophe Chevance, Pierre Ruellou and Dominique Thoreau				
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:				
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371 (c) (2)) <ul style="list-style-type: none"> a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). </p> <p>6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input checked="" type="checkbox"/> A copy of the International Search Report (PCT/ISA/210). attached to Item 13</p> <p>8. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3)) <ul style="list-style-type: none"> a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made. </p> <p>9. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>10. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).</p> <p>11. <input checked="" type="checkbox"/> A copy of the International Preliminary Examination Report (PCT/IPEA/409).</p> <p>12. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).</p>				
Items 13 to 20 below concern document(s) or information included:				
<p>13. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>14. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>15. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p>16. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>17. <input type="checkbox"/> A substitute specification.</p> <p>18. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>19. <input checked="" type="checkbox"/> Certificate of Mailing by Express Mail 20. Return postcard receipt</p>				
20. Other items or information <u>CERTIFICATE OF MAILING UNDER 37 CFR 1.10</u>				
EL682442437US		March 5, 2001		
"Express Mail" mailing no.		Date of Deposit		
I hereby certify that this application is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.				
Anelia F. Urban		<u>Anelia F. Urban</u>		
Typed or printed name of person mailing application		Signature of person mailing application		

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

INTERNATIONAL APPLICATION NO.

ATTORNEY'S DOCKET NUMBER

09/786432

21. The following fees are submitted.:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5) :

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1000.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$710.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00

CALCULATIONS PTO USE ONLY

ENTER APPROPRIATE BASIC FEE AMOUNT =

860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than 20 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	13 - 20 =	0	x \$18.00
Independent claims	1 - 3 =	0	x \$80.00
Multiple Dependent Claims (check if applicable).			<input type="checkbox"/>
TOTAL OF ABOVE CALCULATIONS =			860.00
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable).			<input type="checkbox"/>
SUBTOTAL =			860.00
Processing fee of \$130.00 for furnishing the English translation later than 20 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			<input type="checkbox"/> +
TOTAL NATIONAL FEE =			860.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).			<input type="checkbox"/>
TOTAL FEES ENCLOSED =			860.00
			Amount to be: refunded \$
			charged \$ 860.00

 A check in the amount of _____ to cover the above fees is enclosed. Please charge my Deposit Account No. 07-0832 in the amount of \$860.00 to cover the above fees. A duplicate copy of this sheet is enclosed. The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 07-0832 A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Mr. Joseph S. Tripoli
THOMSON multimedia Licensing Inc.
Patent Department
PO Box 5312
Princeton, New Jersey 08540



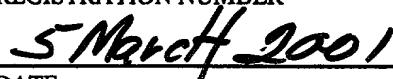
SIGNATURE

Eric P. Herrmann

NAME

29,169

REGISTRATION NUMBER



DATE

10 MAR - L AM 1:38

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Christophe Chevance, Pierre Ruellou and
Dominique Thoreau

Filed : Herewith - PCT National Phase of PCT/EP99/06556

For : METHOD OF MOTION ESTIMATION FOR TRANSMISSION
COST REDUCTION OF MOTION VECTORS

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Sir:

In the US national phase application of PCT/EP99/06556
please enter the following amendments.

IN THE SPECIFICATION

Please amend the specification as follows:

Page 1, line 4, after the title, insert the following:

--This application claims the benefit under 35 U.S.C.
§ 365 of International Application PCT/EP99/06556, filed September 6,
1999, which was published in accordance with PCT Article 21(2) on
March 16, 2000 in English, and which claims the benefit of French Application
No. 9811140, filed September 7, 1998.

BACKGROUND OF THE INVENTION

1. Field of the Invention--

Page 1, line 6, insert as heading: --SUMMARY OF THE INVENTION--

Page 2, line 31 insert as heading: --BRIEF DESCRIPTION OF THE
DRAWING--

Page 3, line 9 insert as heading: --DETAILED DESCRIPTION--

IN THE CLAIMS:

Claims in condition for publication are included on a separate sheet.

Page 11, line 1 delete title, "Claims" and replace with –What is claimed is:--

Please amend the claims as follows:

1. Method of movement estimation for a sequence of images including segmentation of a current video image into image blocks, movement estimation per image block in order to obtain a movement vector field for said current image, a stage of reassignment of a vector to a block by selecting one movement vector from among N predominant vectors, [characterized in that] wherein the predominant vectors are the ones of the group of vectors belonging to the movement vector field of said current image and at least to the movement vector field of a preceding image, the vectors being scaled according to the temporal distance to which they correspond.

2. (Amended) Method according to Claim 1, [characterized in that] wherein, for a predominant vector, second-order regional maxima are detected so as not to be taken into account during the selection of the other predominant vectors.

3. (Amended) Method according to Claim 1, [characterized in that] wherein the predominant vectors are selected in each of the four directions.

4. (Amended) Method according to Claim 1, [characterized in that] wherein the selection of the reassigned vector is based on the value of the displaced frame difference (DFD).

5. (Amended) Method according to Claim 4, [characterized in that] wherein, if the DFDs associated with the N predominant vectors are greater than the DFD associated with the original vector, the zero vector is adopted.

6. (Amended) Method according to Claim 4, [characterized in that] wherein, if the DFDs associated with the N predominant vectors are greater

than the weighted DFD associated with the original vector, the original vector is kept.

7. (Amended) Method according to Claim 1, [characterized in that] wherein the selection of the reassigned vector is based on the calculation of the activity (spatial gradient) in the inter-image difference block (current block -estimated block).

8. (Amended) Method according to Claim 7, [characterized in that] wherein, if the activities corresponding to the N predominant vectors are greater than the activity corresponding to the original vector, the zero vector is adopted.

9. (Amended) Method according to Claim 7, [characterized in that] wherein, if the activities corresponding to the N predominant vectors are greater than the weighted activity corresponding to the original vector, the original vector is kept.

10. (Amended) Method according to Claim 4, [characterized in that] wherein the components of the vectors used during the DFD calculations are the spatially filtered components.

11. (Amended) Method according to Claim 7, [characterized in that] wherein the components of the vectors used during the spatial-gradient calculations are the spatially filtered components.

12. (Amended) Method according to Claim 1, [characterized in that] wherein the vectors of the preceding images, in addition to being scaled, are weighted as a function of the temporal distance.

13. (Amended) Method according to Claim 1, [characterized in that] wherein, when a break in movement is detected, the vectors of the preceding images are not considered.

REMARKS

The specification has been amended to include a reference to the priority applications.

The above amendments to the claims have been made to meet the requirements of the USPTO.

A replacement Abstract is supplied on a separate sheet.

No fee is believed to have been incurred by virtue of this amendment. However if a fee is incurred on the basis of this amendment, please charge such fee against deposit account 07-0832.

Respectfully submitted,
Christophe Chevance
Pierre Ruellou
Dominique Thoreau



Guy H. Eriksen
Guy H. Eriksen
Registration No. 41,736
609/734-9699

THOMSON multimedia Licensing Inc.
Patent Operation
PO Box 5312
Princeton, NJ 08543-5312

March 5, 2001

What is claimed is:

1. Method of movement estimation for a sequence of images including segmentation of a current video image into image blocks, movement estimation per image block in order to obtain a movement vector field for said current image, a stage of reassignment of a vector to a block by selecting one movement vector from among N predominant vectors, wherein the predominant vectors are the ones of the group of vectors belonging to the movement vector field of said current image and at least to the movement vector field of a preceding image, the vectors being scaled according to the temporal distance to which they correspond.

2. Method according to Claim 1, wherein, for a predominant vector, second-order regional maxima are detected so as not to be taken into account during the selection of the other predominant vectors.

3. Method according to Claim 1, wherein the predominant vectors are selected in each of the four directions.

4. Method according to Claim 1, wherein the selection of the reassigned vector is based on the value of the displaced frame difference (DFD).

5. Method according to Claim 4, wherein, if the DFDs associated with the N predominant vectors are greater than the DFD associated with the original vector, the zero vector is adopted.

6. Method according to Claim 4, wherein, if the DFDs associated with the N predominant vectors are greater than the weighted DFD associated with the original vector, the original vector is kept.

10

7. Method according to Claim 1, wherein the selection of the reassigned vector is based on the calculation of the activity (spatial gradient) in the inter-image difference block (current block -estimated block).

5 8. Method according to Claim 7, wherein, if the activities corresponding to the N predominant vectors are greater than the activity corresponding to the original vector, the zero vector is adopted.

10 9. Method according to Claim 7, wherein, if the activities corresponding to the N predominant vectors are greater than the weighted activity corresponding to the original vector, the original vector is kept.

15 10. Method according to Claim 4, wherein the components of the vectors used during the DFD calculations are the spatially filtered components.

11. Method according to Claim 7, wherein the components of the vectors used during the spatial-gradient calculations are the spatially filtered components.

20 12. Method according to Claim 1, wherein the vectors of the preceding images, in addition to being scaled, are weighted as a function of the temporal distance.

25 13. Method according to Claim 1, wherein, when a break in movement is detected, the vectors of the preceding images are not considered.

14
ABSTRACT

The method includes segmentation of the video image into image blocks, movement estimation per image block in order to obtain a field of movement vectors. It is characterized in that it includes a stage of reassignment of a vector to a block by selecting one movement vector from among N predominant vectors belonging to the field of vectors.

The applications relate to movement estimation, for example, by image-block matching.

WO 00/14682

METHOD OF MOTION ESTIMATION FOR TRANSMISSION
COST REDUCTION OF MOTION VECTORS

The invention relates to a method of movement
5 estimation applied to MPEG-type video coding.

The majority of movement-estimation algorithms implemented in video coding use the technique of "block matching".

10 The image is segmented into blocks of size $N \times N$, called macroblocks, and the estimator searches for the vector minimizing the difference between a block of the current image and a block of the reference image. This difference is generally an MSE (Mean Square Difference) or MAE (Mean Absolute Difference) calculated on the
15 luminance pixels.

This type of estimator can supply a heterogeneous movement field since it is based on the variations of luminance and not on the actual movement in the sequence. This may entail an overhead for the coding of the vectors by the coder, the coding generally being of differential type, and thus a reduction in
20 performance.

The object of the invention is to remedy the abovementioned drawbacks.

25 Its subject is a method of movement estimation including segmentation of the video image into image blocks, movement estimation per image block in order to obtain a movement vector field, characterized in that it includes a stage of reassignment of a vector to a
30 block by selecting one movement vector from among N predominant vectors belonging to the vector field.

According to one particular implementation, for a predominant vector, second-order regional maxima are detected so as not to be taken into account during the
35 selection of the other predominant vectors.

According to another implementation, the predominant vectors are selected in each of the four directions.

According to a particular implementation of the method, the selection of the reassigned vector is based on the value of the inter-displaced-image difference (DFD).

5 A particular characteristic of the invention consists in adopting the zero vector if the DFDs associated with the N predominant vectors are greater than the DFD associated with the original vector, or in actually keeping the original vector if the DFDs associated with the N predominant vectors are greater than 10 the weighted DFD associated with the original vector.

According to another implementation of the method, the selection of the reassigned vector is based 15 on the calculation of the activity (spatial gradient) in the inter-image difference block (current block - estimated block). If the activities corresponding to the N predominant vectors are greater than the activity corresponding to the original vector, the zero vector is adopted. If the activities corresponding to the N 20 predominant vectors are greater than the weighted activity corresponding to the original vector, the original vector is kept.

According to another particular implementation 25 of the method, for each image, the predominant vectors are chosen from among the field of vectors of the current image and the field of vectors of at least one preceding image.

By virtue of the invention, the movement vector fields calculated by an estimator of the "block matching" type can be homogenized.

The characteristics and advantages of the invention will emerge better from the following description, given by way of example and by reference to the attached figures, in which:

35 - Figure 1 represents a histogram of the movement vectors,

- Figure 2 represents a regional-maxima search window,

- Figure 3 represents an example of median filtering,

- Figure 4 represents an example of the preceding image vectors being taken into account,

5 - Figure 5 represents movement-vector fields during a zoom,

- Figure 6 represents various types of movement which may be detected.

The homogenization of the vector field is
10 obtained via a method of conditional reassignment.

The vectors, associated with the images of a sequence, are calculated and stored by the estimator.

In order to carry out processing on the vectors, a two-dimensional histogram is constructed with
15 dimensions of 512*512 in which the coordinates represent the values (dx, dy) which are the values of the horizontal and vertical components of these vectors.

Figure 1 represents, on the left-hand part, an image consisting of macroblocks to which the movement
20 vectors are allocated and, on the right-hand part, the corresponding histogram.

Choice of predominant vectors

In order to make the movement field more homogeneous, the idea is to adopt a certain number of vectors, which is fixed in the first place by the user.
25 This number will be larger in proportion to the heterogeneity of the movements.

The first solution consists in adopting the N vectors corresponding to the highest frequencies of
30 appearance.

Another possibility is to stipulate that the algorithm choose N/4 predominant vectors in each of the four orientation planes. This solution can be adopted as an option, as an output criterion upon detection of
35 zoom in the sequence. This is because such a phenomenon entails distribution in all directions of the vector field.

The last solution envisaged is to carry out detection of the regional maxima. This is because the

problem, in the first solution, is that it is possible to have several contiguous maxima, which do not confer enormous advantages compared with the fact of adopting fewer of them.

5 The histogram is therefore scanned, rejecting those vectors among the N predominant vectors appearing in the vicinity of other more predominant vectors. Thus the existence of these second-order maxima is identified by looking at the histogram to see whether two
10 maxima lie in the same window, for example with dimensions $3*3$.

Figure 2 represents such a window, referenced 1, for searching for regional maxima, this window being centred around the predominant vector adopted (dX, dY) ,
15 the number of occurrences of which is n .

Choice of the vector allocated to a macroblock MB. Re-assignment

- Method of the DFD

Once the predominant vectors have been
20 extracted, a criterion remains to be found for reassigning each of these vectors to each MB. Since the movement estimator uses the criterion of the minimum DFD (Displaced-Frame Difference) to calculate the movement vectors, it seems useful to use this criterion to
25 find the best possible correspondence between the vectors adopted and the macroblocks of the image to be processed.

After ordering the vectors in increasing order of their frequency of appearance, the calculation of
30 DFD associated with each of these vectors is carried out for each MB. This calculation can be expressed simply by the following formula:

$$Dfd(i, j) = \sum_{k=0}^{N-1} \sum_{l=0}^{N-1} | MBCurrent(i+k, j+l) - MBReference(i+k+dy, j+l+dx) |$$

35 in which (i, j) are the coordinates of the MB to be processed;

N ($= 16$) is the size of the MB;

(dx, dy) are the components of the vector to be tested, belonging to [-128; +127.5].

It is important, before applying this formula, to check that the vector to be tested does not point 5 outside the reference image. If no vector is suitable, then the zero vector is assigned.

Hence the vector corresponding to the minimum DFD is assigned to each MB.

- Gradient method

10 This consists in seeking, for each MB of the "difference" image consisting of the predicted reference image and of the current image, the vector corresponding to the minimum gradient which gives information on the local activity of the MB (of horizontal and 15 vertical gradient type).

$$\text{MB_gradient} = \sum_{\text{4luma blocks}} \text{block_active}$$

20 with:

$$\text{block_active} = \text{MAX} \left(\left| \max_{i,j=0}^{i=6,j=7} |x(i,j) - x(i+1,j)| \right|, \left| \max_{i,j=0}^{i=7,j=6} |x(i,j) - x(i,j+1)| \right| \right)$$

Enhancement of the reassignment

DFD/Gradient criterion

25 In order to keep certain movements, relating to objects of small size, the following criterion is defined:

If, after application of the DFD method, the vector adopted for an MB generates a DFD greater than the weighted original DFD, the original vector is kept.

30 Likewise, regarding the method of the gradient, for each MB obtained after inter-image difference, the gradient obtained by reassignment is compared with the gradient of the original vector. If the weighted original gradient is less than the new gradient, the original 35 vector is kept.

Filtering applied to the movement vectors

In order to make the vector fields more homogeneous, other criteria may be used, namely spatial or temporal filtering.

5 - Spatial filtering

The filter adopted is the two-dimensional 3*3 median filter:

the principle is explained below in the light of Figure 3 which represents an image referenced 2 before filtering and an image referenced 3 after filtering. The vector referenced 4 is the vector to be processed.

15 The vertical and horizontal neighbours of the components of the MB in question are ordered along each direction (dx, dy), then the median value of each component is taken. Next the various DFDs associated with each MB are compared, in the case in which either one component is filtered, or both, or no component is filtered. Hence the vector corresponding to the minimum 20 DFD is chosen, the original DFD, obviously, being weighted.

- Temporal filtering

25 The idea of temporal coherence is to take account, in the reassignment of the vectors of an image, of the movement fields of the preceding images; this is done with a view to limiting the disparity in the movements from one image to another.

To begin with, we will detail the principle of temporal filtering of Forward vectors (deferred-movement vectors).

Spatio-temporal histogram of Forward vectors:

35 In order to take account of the various histograms, scaling of the vectors is carried out at a first stage, then weighting of the occurrences which is a function of the position of the various histograms with respect to the histogram processed.

Hence, for the P image of Figure 4, it is possible to add to the histogram of original vectors, the occurrences of which have been weighted by a factor 3,

the occurrences of the vectors of the first B (the amplitude of which has been multiplied by 3) which are weighted by a factor 1 as well as the occurrences of the vectors of the second B (the amplitude of which has been multiplied by 3/2) which are weighted by a factor 2.

Temporal coherence should be relevant when uniform movements are present, and breaks in movement (change of scene) are not present.

10 Case of Backward vectors (anticipated-movement vectors)

It would be logical to think that, if there are uniform "Forward" movements from one image to the next, they would also be present in the case of the "Backward" vectors associated with the B images. In order to filter the latter, it must not be forgotten that the Backward vectors are based on the P or the I which will follow the B in question. Hence, for the first B, it may be thought that its Backward vectors will be twice as large as the Backward vectors associated with the second B. Scaling is carried out on the vectors of the latter by a factor of 2, and the weighted occurrences will be added, in the histogram associated with the first B.

25 Detection of uniform field

The idea of applying the reassignment with N vectors on sequences with multidirectional movements such as a zoom, for example, is not relevant. This is because, in this fairly specific case, the fact of adopting only N predominant vectors does not make it possible conveniently to process the fields consisting of multiple vectors.

30 Figure 5 represents the image of the vectors during the zoom. It can easily be seen that the disparity in the field does not allow any such uniformity.

It is therefore decided to detect, in the first place, a field in which the vectors are uniformly distributed, either unilaterally, or in all directions (zoom). This detection is conveyed by a standard devia-

tion of the first predominant vector close to the average standard deviation calculated from among the N predominant vectors. This is expressed as:

if $\sigma_1 \leq \text{threshold} * \sigma_{\text{average}}$ => uniform field present
5 in which the threshold is fixed by the user
(threshold = 1.34 for example).

Examples relating to the types of movements which are successfully detected are represented in Figures 6a, b, c, d.

10 The objective is, at present, not to apply the algorithm when cases (c) and (d) are present. These cases have still to be distinguished from cases (a) and (b). To do that the average values of the dx and dy movements are examined, from among the N adopted, and
15 it is seen whether they are close to zero. This is because it may be observed that the movements in a zoom seem to cancel out if they are added, in contrast to unilateral movement. A maximum difference of five pixels can be set for dx, dy.

20 Limitation on the temporal filtering

It is useful not to have to filter the histograms temporally in the event of breaks in movement. It is possible:

25 - to store the histogram of initial or reassigned vectors for a P-type image;

- at the next P-type image, P (t), the new "image" vectors are compared. If they differ too much from their counterparts arising from P (t - n), the original vectors are kept.

30 Choice of the Number of Predominant Vectors

The number of vectors necessary may be decided automatically and dynamically, in such a way that, for sequences with random movements (for example a sporting sequence), there are more vectors than for sequences 35 with uniform movements ("train").

Claims

1. Method of movement estimation for a sequence of images including segmentation of a current video image into image blocks, 5 movement estimation per image block in order to obtain a movement vector field for said current image, a stage of reassignment of a vector to a block by selecting one movement vector from among N predominant vectors, characterized in that the predominant vectors are the ones of the group of vectors belonging to the movement vector field of said current image and at 10 least to the movement vector field of a preceding image, the vectors being scaled according to the temporal distance to which they correspond.

2. Method according to Claim 1, characterized in that, for a 15 predominant vector, second-order regional maxima are detected so as not to be taken into account during the selection of the other predominant vectors.

3. Method according to Claim 1, characterized in that the predominant vectors are selected in each of the four directions.

4. Method according to Claim 1, characterized in that the selection 20 of the reassigned vector is based on the value of the displaced frame difference (DFD).

5. Method according to Claim 4, characterized in that, if the DFDs associated with the N predominant vectors are greater than the DFD associated with the original vector, the zero vector is adopted.

25 6. Method according to Claim 4, characterized in that, if the DFDs associated with the N predominant vectors are greater than the weighted DFD associated with the original vector, the original vector is kept.

7. Method according to Claim 1, characterized in that the selection 30 of the reassigned vector is based on the calculation of the activity (spatial gradient) in the inter-image difference block (current block -estimated block).

8. Method according to Claim 7, characterized in that, if the activities corresponding to the N predominant vectors are greater than the activity corresponding to the original vector, the zero vector is adopted.

9. Method according to Claim 7, characterized in that, if the activities corresponding to the N predominant vectors are greater than the weighted activity corresponding to the original vector, the original vector is kept.

10. Method according to Claim 4, characterized in that the components of the vectors used during the DFD calculations are the spatially filtered components.

11. Method according to Claim 7, characterized in that the components of the vectors used during the spatial-gradient calculations are the spatially filtered components.

12. Method according to Claim 1, characterized in that the vectors of the preceding images, in addition to being scaled, are weighted as a function of the temporal distance.

13. Method according to Claim 1, characterized in that, when a break in movement is detected, the vectors of the preceding images are not considered.

1/3

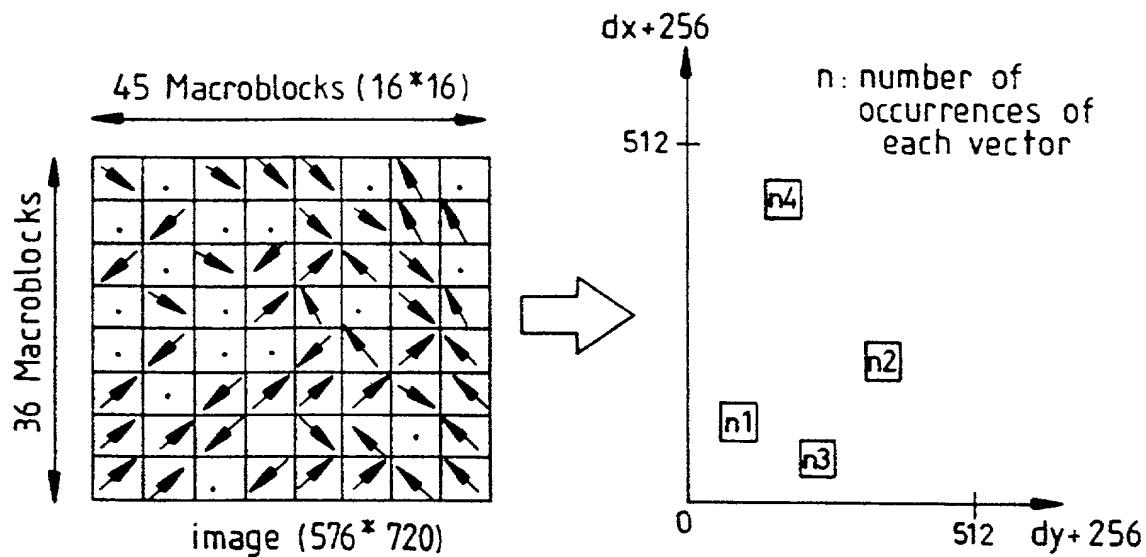


FIG.1

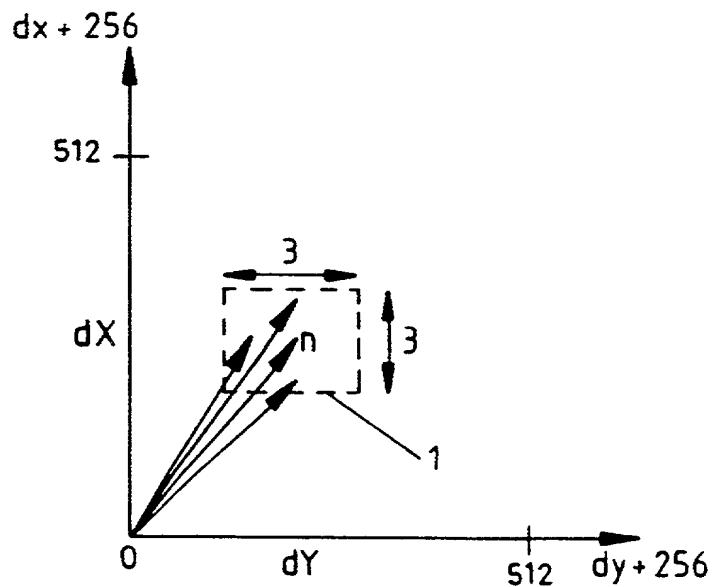


FIG.2

SUBSTITUTE SHEET (RULE 26)

2/3

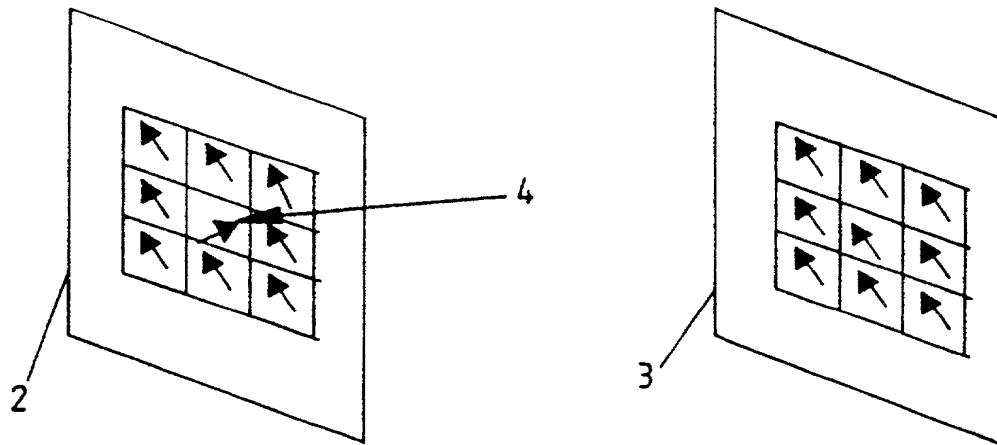


FIG. 3

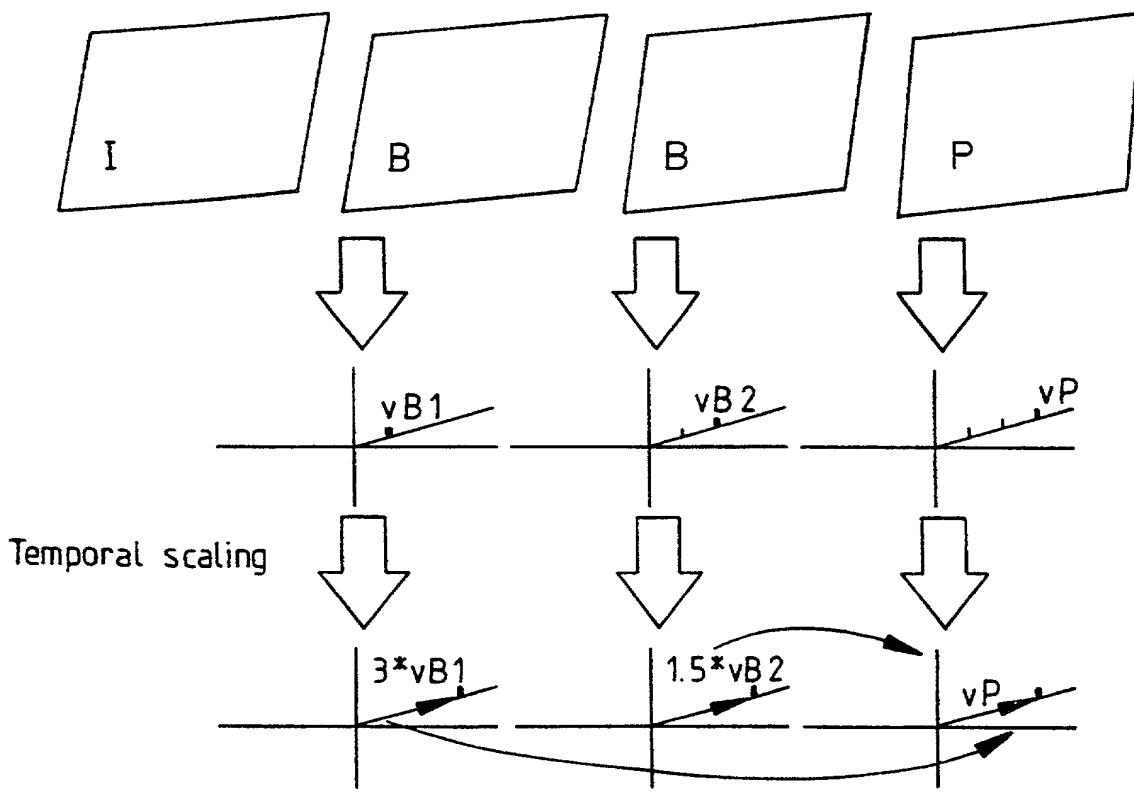


FIG. 4

SUBSTITUTE SHEET (RULE 26)

3/3

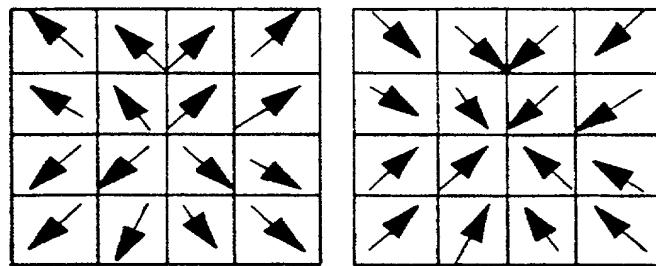


FIG.5

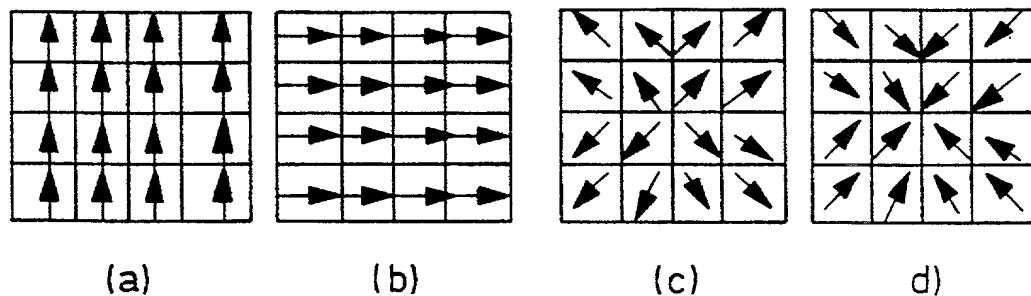


FIG.6

DECLARATION FOR UNITED STATES PATENT APPLICATION,
POWER OF ATTORNEY, DESIGNATION OF CORRESPONDENCE ADDRESS

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD OF MOTION ESTIMATION FOR TRANSMISSION COST REDUCTION OF MOTION VECTORS /

the specification of which

(CHECK ONE) () is attached hereto.
(XX) was filed on September 6, 1999, Application Serial. No. PCT/EP99/06556 and was amended on .

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR 1.56(a).

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent, utility model, design or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
Number	Country	Date Filed	Yes	No
9811140	FR	September 7, 1998	✓	xx

I hereby claim the benefit under 35 USC 120 of any US Application(s) listed below, and, insofar as the subject matter of each of the claims of this Application is not disclosed in the prior US application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR 1.56(a)

Serial No.: Filed:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under of 18 USC 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Joseph S. Tripoli (Reg. No. 26,040), Dennis H. Irlbeck (Reg. No. 26,372), Eric Herrmann (Reg. No. 29,169) and Joseph J. Laks (Reg. No. 27,914) Telephone: (609) 734-9813.

Address all correspondence to Joseph S. Tripoli, Patent Operations - Thomson multimedia Licensing, Inc. - CN 5312 - Princeton, New Jersey 08543-0028.

Signature: Pierre Ruelou Date: 29 day of January, 2001.

1-00 Sole or First Joint Inventor: Christophe Chevance

Citizenship: FR

Residence and Post Office Address:

4 allée J.J. Audubon
F- 35200 Rennes FRX
France

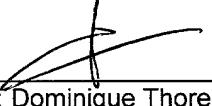
2-00 Signature: Pierre Ruelou Date: 29 day of January, 2001

Sole or First Joint Inventor: Pierre Ruelou

Citizenship: FR

Residence and Post Office Address:

15 rue des Coquelicots
F- 35410 Domloup FRX
France

3-00 Signature:  Date: 29 day of January, 2001.

Sole or First Joint Inventor: Dominique Thoreau

Citizenship: FR

Residence and Post Office Address:
39 rue du Réage
F- 35510 Cesson-Sévigné
France FRX

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Christophe Chevance, Pierre Ruellou and
Dominique Thoreau

Filed : Herewith

For : METHOD OF MOTION ESTIMATION FOR TRANSMISSION
COST REDUCTION OF MOTION VECTORS

APPOINTMENT OF ASSOCIATE ATTORNEY

Hon. Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

I, Eric P. Herrmann, an attorney of record, hereby appoint
Guy H. Eriksen, Reg. No. 41,736, as an associate attorney in the above-
identified application, with full power to prosecute the above-identified
application, to make alterations and amendments therein, and to transact
all business in the Patent and Trademark Office connected therewith.

PLEASE ADDRESS ALL FUTURE COMMUNICATIONS TO:

Joseph S. Tripoli
Patent Operations
Thomson Multimedia Licensing Inc.
P. O. Box 5312
Princeton, NJ 08543-5312

Respectfully submitted,

Christophe Chevance et al.

By


Eric P. Herrmann, Attorney
Reg. No. 29,169
Tel. No. (609) 734-9754

Patent Operation
Thomson Multimedia Licensing Inc.
P. O. Box 5312
Princeton, New Jersey 08543-5312

March 5, 2001